1 Combinatorics

	With Replacement	Without Replacement
Permutations (Ordered)	$P_r(n,k) = n^k$	$P(n,k) = \frac{n!}{(n-k)!}$
Combinations (Unordered)	$C_r(n,k) = \binom{n+k-1}{k} = \frac{(n+k-1)!}{k!(n-1)!}$	$C(n,k) = \binom{n}{k} = \frac{n!}{k!(n-k)!}$

2 Distributions

Distribution	Moments	Bernoulli	Binomial	Geometric	Poisson	Exponential	Uniform	Normal
PDF		$p^x(1-p)^{1-x}$	$\binom{n}{x}p^x(1-p)^{n-x}$	$(1-p)^{x-1}p$	$\mathrm{e}^{-\lambda}\frac{\lambda^x}{x!}$	$\frac{1}{\lambda}\mathrm{e}^{\frac{-x}{\lambda}}$	$\frac{1}{b-a}$	$\frac{1}{\sqrt{2\pi\sigma^2}}\mathrm{e}^{\frac{-(x-\mu)^2}{2\sigma^2}}$
E[X]	$\bar{X} = \frac{1}{n}\sum_{i=1}^{n} X_i$	p	np	$\frac{1}{p}$	λ	λ	$\frac{a+b}{2}$	μ
Var[X]	$E[X^2] = \frac{1}{n}\sum_{i=1}^{n}(X_i - \bar{X})^2$	$p(1-p)$	$np(1-p)$	$\frac{1-p}{p^2}$	λ	λ^2	$\frac{(b-a)^2}{12}$	σ^2

3 Percentiles; $Q \sim Normal(\mu_Q = 80, \sigma_Q^2 = 9)$; percentile = 97.5

$$P(Q \leq q_0.975) = 0.975 \tag{1}$$

$$P(Z \leq \frac{q_0.975 - 80}{3}) = 0.975 \tag{2}$$

$$\frac{q_0.975 - 80}{3} = 1.96 \tag{3}$$

$$q_0.975 \approx 85.88 \tag{4}$$

So x_Q does not fall within percentile if $x_Q < q_0.975$

4 Hypothesis Testing

H_0	H_A	Conditions	Test Statistic	Rejection Region	Degrees of freedom
$\mu_1 = \mu_2$	$\mu_1 < \mu_2$ $\mu_1 > \mu_2$ $\mu_1 \neq \mu_2$	Known σ	$Z = \frac{(\bar{X}_1 - \bar{X}_2) - (\mu_1 - \mu_2)}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}$	$Z < -z_\alpha$ $Z > z_\alpha$ $\lvert Z\rvert > \lvert z_{\alpha/2}\rvert$	
$\mu_1 = \mu_2$	$\mu_1 < \mu_2$ $\mu_1 > \mu_2$ $\mu_1 \neq \mu_2$	Unknown but equal σ $s^2 = \frac{1}{n-1}\sum_{i=1}^{n}(x_i - \bar{x})^2$ $s_p^2 = \frac{(n_1-1)s_1^2 + (n_2-1)s_2^2}{n_1+n_2-2}$	$t = \frac{(\bar{X}_1 - \bar{X}_2) - (\mu_1 - \mu_2)}{\sqrt{s_p{}^2(\frac{1}{n_1} + \frac{1}{n_2})}}$	$t < -t_{df,\alpha}$ $t > t_{df,\alpha}$ $\lvert t\rvert > \lvert t_{df,\alpha/2}\rvert$	$df = n_1 + n_2 - 2$
$\pi_1 = \pi_2$	$\pi_1 < \pi_2$ $\pi_1 > \pi_2$ $\pi_1 \neq \pi_2$	Z-test for proportions	$Z = \frac{(\hat{\pi}_1 - \hat{\pi}_2) - (\pi_1 - \pi_2)}{\sqrt{\frac{\hat{\pi}_1(1-\hat{\pi}_1)}{n_1} + \frac{\hat{\pi}_2(1-\hat{\pi}_2)}{n_2}}}$	$Z < -z_\alpha$ $Z > z_\alpha$ $\lvert Z\rvert > \lvert z_{\alpha/2}\rvert$	
$\beta_1 = 0$	$\beta_1 \neq 0$	Test for linear relationship	$t = \frac{\hat{\beta}_1 - \beta_1}{\sqrt{\frac{s^2}{S_{xx}}}}$	$t > \lvert t_{df,\alpha/2}\rvert$	$df = n - 2$

5 Linear Regression Formulas

$$\hat{\beta}_0 = \bar{y} - \hat{\beta}_1\bar{x} \tag{5}$$

$$\hat{\beta}_1 = \frac{S_{xy}}{S_{xx}} \tag{6}$$

$$S_{xx} = \sum_{i=1}^{n}(x_i - \bar{x})^2 \tag{7}$$

$$S_{xy} = \sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y}) \tag{8}$$

$$SS_{RESID} = \sum_{i=1}^{n}(y_i - \hat{y}) \tag{9}$$

$$RegressionVariance : s^2 = \frac{SS_{RESID}}{n-2} \tag{10}$$